

Application of a multi-agent system for monitoring market trends on the example of cryptocurrencies

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Abstract. Due to the increasing volume of innovations emerging daily across various domains, there is a growing need to efficiently filter and identify information relevant to users in specific fields, without requiring excessive time and effort. The processes of searching and analyzing information can be exhausting, often involving the review of large volumes of text and diverse sources. This paper presents the application of a multi-agent system for the automated collection, filtering, and analysis of information, using the CrewAI framework, with a focus on the cryptocurrency market. The system enables users to efficiently access concise and relevant insights on cryptocurrency price movements and market trends with minimal manual input. It is powered by a semantic search engine that allows meaning-based retrieval of content, ensuring access to highly relevant data from a variety of sources. This approach supports effective market analysis and trend forecasting, ultimately helping economists and investors make better decisions, optimize resources, and reduce risk.

Keywords: Multi-agent system, large language models, semantic search engines, cryptocurrency, automation, information filtering, market research.

1 Introduction

With the ever-growing influx of information in various fields, such as cryptocurrencies, it has become increasingly challenging for users to effectively filter and analyze data to make informed decisions. Monitoring cryptocurrency market trends is particularly complex due to their volatility and the impact of economic, political, and technological factors. An automated system that collects and analyzes cryptocurrency price movements could help users manage risks and make better investment decisions. Such a system would be valuable not only to investors, but also to analysts, media organizations, regulatory bodies, fintech entrepreneurs, and academic institutions engaged in cryptocurrency research.

As part of the methodological framework, this study focuses on three key aspects. The first involves evaluating the effectiveness of automated analysis in comparison to traditional methods, through a comparison of results generated with a limited agent setup versus those obtained using the full system configuration. The second examines the system's ability to detect shifts in market trends by integrating multiple data types, including technical indicators and textual inputs from news and social media. The third addresses the accuracy and interpretive value of automatically generated summaries,

which were compared against core market data to assess their consistency and practical relevance.

To realize this objective, a multi-agent system based on the CrewAI framework was implemented. It coordinates agents tasked with retrieving information, filtering irrelevant data, and analyzing cryptocurrency market dynamics. Information retrieval is handled by two key components: the CoinGecko API, which provides real-time price and volume data for major cryptocurrencies, and the Exa AI semantic search engine, which supports meaning-based queries to extract relevant content from sources such as media articles, forums, and social networks. In addition, large language models (LLaMA) are employed to generate concise summaries, enabling efficient interpretation of the agents' outputs. These summaries are presented in a structured, user-friendly format via HTML templates to enhance readability.

By combining the CrewAI framework with the Exa AI search engine, the system automatically gathers and filters relevant online information. Semantic search ensures that only the most meaningful data is retained, providing users with actionable insights into price movements of major cryptocurrencies (e.g., Bitcoin, Ethereum, BNB, XRP, Solana). These reports support better understanding of market changes and promote faster, more informed decision-making while reducing cognitive and operational overhead.

This study demonstrates the feasibility of using multi-agent systems to automate cryptocurrency market tracking, significantly accelerating data analysis while improving decision quality. Moreover, the system's results can be cross-validated against conventional methods, ensuring both reliability and analytical consistency.

The paper is organized into five main sections. Following the introduction, which outlines the motivation and objectives of the study, Section 2 provides an overview of related work on multi-agent systems and the integration of large language models in financial analysis. Section 3 presents the tools and methodology used to build the proposed solution, including the CrewAI framework, Exa AI semantic engine, and LLaMA-based language models. Section 4 outlines the architecture of the developed system and discusses experimental results through selected examples and outputs generated by individual agents. Finally, Section 5 concludes the paper by summarizing key findings and identifying limitations, along with suggestions for future improvements and applications.

2 Related Work

Multi-agent systems (MAS) have been widely applied across various disciplines such as computer science, civil engineering, and electrical engineering, due to their flexibility in solving complex, distributed problems. Agents in MAS are autonomous, proactive, and social entities capable of collaborating efficiently to complete assigned tasks. However, MAS face significant challenges including agent coordination, security, and task allocation, which are critical for ensuring system success and efficiency. Furthermore, communication mechanisms between agents and performance evaluation

methods are essential components for analyzing MAS effectiveness. Dorri et al. (2018) provide a comprehensive survey covering MAS definitions, taxonomies, applications, challenges, and future research directions, emphasizing the importance of communication and evaluation in MAS design [1].

Recent studies have integrated large language models (LLMs) into MAS to simulate complex economic and financial activities. Li et al. [2] introduced EconAgent, a framework where LLM-empowered agents simulate macroeconomic behavior with human-like reasoning. Similarly, the LLM-Powered Crypto Portfolio Management system [3] introduces multimodal agents that collaborate within and across teams, enhancing efficiency, predictive accuracy, and decision explainability. Yu et al. [4] further developed FinCon, an LLM-based MAS using conceptual verbal reinforcement to improve financial decision-making.

Additionally, multi-agent reinforcement learning (MARL) has been used to model crypto markets. One example is SYMBA [5], which uses historical stock market data to train agents capable of forecasting prices and optimizing strategies within a simulated market microstructure. Oprea and Băra [6] proposed a MAS for cryptocurrency trading, combining five specialized agents and LLMs to support strategic planning and risk management.

Together, these studies show that MAS outperform single-agent models through agent specialization, collaborative mechanisms, integration of diverse data sources, and adaptive learning capabilities. As a result, MAS offer greater accuracy, robustness, and interpretability—making them especially suitable for dynamic and volatile cryptocurrency markets.

3 Tools and methodology

Large language models, such as GPT and BERT, represent advanced AI systems for understanding and generating natural language, and their application is becoming increasingly broad, including within multi-agent systems. Multi-agent systems enable the collaboration of multiple autonomous agents in solving complex problems, making them well-suited for dynamic and demanding environments such as crypto-currency markets.

This paper presents a modular multi-agent system for the automated tracking and analysis of cryptocurrency market trends, based on the CrewAI framework. The system integrates multiple tools, including the Exa AI semantic search engine and the LLaMA language model, while the agents are specialized for collecting, filtering, and analyzing data from various sources.

This methodology enables the efficient extraction and presentation of relevant information to users, with minimal manual work. A detailed description of the system architecture, the tools used, and the experimental results is provided in the following chapters.

3.1 CrewAI

CrewAI [7] is an open-source framework designed to create multi-agent applications for process automation. Through the collaboration of multiple agents, CrewAI enables the efficient resolution of complex tasks that require different skills and perspectives. The system is designed to integrate various language models and tools, and is used in areas such as natural language processing, data analysis, task automation, and the creation of interactive AI assistants. Unlike traditional single-agent systems, CrewAI facilitates teamwork between agents who communicate to achieve a common goal.

The main advantages of CrewAI include the ability for agents to collaborate, define roles, a high level of privacy and security, as well as ease of extensibility.

The system architecture allows each agent to take on the appropriate task and use tools to access external data sources. Data is passed to large language models (LLMs) that generate output enabling the achievement of the end goal. The system is flexible and scalable, supports automatic management of agent interactions, as well as defining roles and tasks, making it possible to efficiently manage complex processes. Some of the key concepts of the CrewAI framework include:

- **Agent API** – allows defining agents with specific roles, goals, and tools;
- **Task API** – enables task assignment to agents;
- **Crew API** – manages collaboration between agents;
- **Tools API** – provides access to various tools for task execution;
- **Memory API** – allows agents to remember previous interactions and maintain context;
- **Processes API** – defines workflows between agents and the execution of tasks (sequential or parallel).

CrewAI is designed to be flexible and extensible, with the ability to integrate with various tools and systems such as search engines, text analysis tools, mathematical operations, or image generation. The system allows for the creation of efficient teams of agents who solve complex tasks through coordination and communication, making it suitable for a wide range of applications, from natural language processing to business process automation.

Future development of the CrewAI framework is likely to include enhancements in agent learning mechanisms, more efficient communication between agents, and expanded integration capabilities with other AI and software systems.

3.2 Exa AI

Exa AI [8] is a semantic search engine designed for meaning-based information retrieval. It uses advanced natural language processing models to analyze and understand the contextual structure of textual data. In this research, Exa AI was used for the automatic collection and filtering of relevant information from a wide range of sources, including news articles, social media, and online forums.

Unlike traditional keyword-based search, Exa AI operates on semantic similarity, enabling the identification of content that is contextually aligned with the user's query—even when different vocabulary is used. The results retrieved by the agent are further categorized by topical relevance and emotional polarity (positive, negative, or neutral), providing a context-rich foundation for subsequent interpretation and insight generation.

3.3 Large language models

This study employed the large language model LLaMA3-70B-8192, developed by Meta AI [9]. The model contains 70 billion parameters and uses a context window of 8192 tokens, making it suitable for tasks that require the processing of longer and more complex inputs. It was integrated into the Conclusions Generator agent, where it is used to summarize and interpret the outputs of other agents. Due to its accuracy, stability, and fast performance via the Groq API, this model enables the generation of coherent, informative, and user-oriented outputs.

4 Solution and Discussion System Architecture, Implementation, and Discussion

The proposed solution is a modular multi-agent system designed to autonomously monitor and analyze the cryptocurrency market. Built on the CrewAI framework, the system integrates tools and APIs—including CoinGecko [10], Exa AI, Yahoo Finance [11], and LLaMA3—and coordinates six specialized agents, each responsible for a distinct stage in the data processing pipeline.

The architecture includes a market monitoring agent (Market Scanner), a news retrieval agent (News Aggregator), a pattern recognition agent (Market Pattern Analyst), a correlation analysis agent (Correlation Analyst), a synthesis agent (Conclusions Generator), and a report generation agent (Final Report Creator). Collectively, these agents support the automated collection, contextualization, analysis, and presentation of cryptocurrency market data, providing structured insights with minimal human input. Working in coordination, these agents produce a comprehensive analysis of the cryptocurrency market—including assets such as Bitcoin, Ethereum, BNB, XRP, and Solana—thereby enabling users to make well-informed decisions with greater efficiency. The interaction and workflow between these agents are illustrated in Fig. 1, which presents the overall structure of the system.

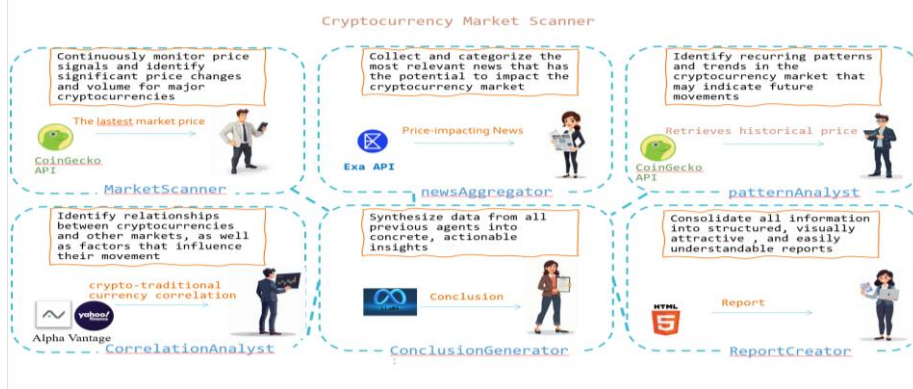


Fig. 1. Agent Workflow in the Cryptocurrency Market Scanner System

The first agent (Market Scanner) in the system is responsible for real-time monitoring of cryptocurrency prices and trading volumes. It uses the CoinGecko API to detect price fluctuations and volatility indicators. The agent produces structured textual reports that summarize market conditions, highlight notable price and volume changes, and provide concise analytical observations for each tracked asset. These reports serve as the factual baseline for subsequent interpretation and synthesis within the system’s analytical pipeline.

The second agent (News Aggregator) collects external textual signals to contextualize numerical trends observed in the market. Powered by Exa AI, it retrieves and filters relevant content from media and social platforms. Its core function is to identify news items that are likely to influence market dynamics—such as developments in regulation, protocol upgrades, strategic partnerships, or security incidents. The agent selects and categorizes the 5 to 10 most impactful entries by sentiment and topical relevance, linking them to specific assets or sectors. By distinguishing substantive events from informational noise, this agent adds an essential narrative layer that supports short-term interpretation and decision-making.

The third agent (Market Pattern Analyst) specializes in detecting recurring patterns in historical price and volume data. Using rule-based logic derived from traditional technical analysis, it identifies features such as trend formations, breakout structures, and support or resistance levels. The agent processes time-series data obtained from CoinGecko and is designed for potential integration with machine learning models. Its output consists of a structured summary of technical signals that may suggest future price movements. The fourth agent (Correlation Analyst) examines statistical dependencies between cryptocurrencies and external financial indicators. It relies on the Yahoo Finance API to retrieve data on traditional markets and computes correlation coefficients such as Pearson or Spearman across variable time windows. The agent generates a matrix of inter-market relationships, highlighting how macroeconomic events, global indices, or commodity prices may influence cryptocurrency behavior.

The fifth agent (Conclusions Generator) synthesizes the outputs of all previous components into concise, actionable insights. It uses the LLaMA3 language model to integrate numerical data, news sentiment, technical signals, and correlation findings into

interpretive summaries. Its output includes short, coherent narratives that outline current market conditions, risks, and strategic recommendations. When upstream agents are unavailable, it draws on embedded reasoning patterns to maintain consistent functionality.

The sixth agent (Final Report Creator) consolidates the entire system output into a structured and visually accessible report. It formats content using pre-defined HTML templates and presents it in thematically organized sections, including market summaries, key news, technical patterns, and correlation analysis. The report is designed for flexible delivery—via dashboards, email, or archival—and ensures that complex analyses are presented in a clear, user-oriented form.

The effectiveness of the system is illustrated through two comparative examples: the first demonstrates results generated using only the Market Scanner and Conclusions Generator agents, while the second incorporates additional inputs from the News Aggregator, Pattern Analyst, and Correlation Analyst to enhance analytical depth and contextual relevance.

To illustrate the system's output structure and inter-agent contributions, Table 1 presents selected examples generated by the three agents used in this particular application: the Market Scanner, Conclusions Generator, and Final Report Creator. These outputs reflect the flow of data from raw numerical analysis to interpretive insight and structured presentation.

Table 1. Selected examples from agent outputs in the analyzed report

Agent	Example
<i>Market Scanner</i>	BTC price: −3.3%, ETH: −1.8%, XRP: −8.0%; high trading volume for BTC and ETH
<i>Conclusions Generator</i>	"Bitcoin's technical breakout", "Regulatory clarity boosts altcoins", "Decreasing correlation with equity markets"
<i>Final Report Creator</i>	Sections: Executive Summary, Market Insights, Technical Analysis, Actionable Takeaways

In this specific configuration, the system operated using three agents. The Market Scanner collected and summarized price and volume data, accurately capturing key movements in assets such as Bitcoin, Ethereum, XRP, ADA, and AVAX, and highlighting elevated trading volumes for BTC and ETH. This output served as the foundational layer, offering a reliable snapshot of current market conditions.

Building on this, the Conclusions Generator interpreted the data to produce higher-level insights. Without drawing on external inputs, it logically inferred, for example, a potential “Bitcoin's technical breakout” based on volume patterns, and added contextual

depth by referencing themes such as regulatory clarity and decoupling from equity markets. These interpretations, while not explicitly present in the raw data, were consistent with embedded domain logic and heuristic reasoning.

Finally, the Final Report Creator compiled all outputs into a cohesive document, organizing content into clearly labeled sections such as Executive Summary, Technical Analysis, and Actionable Takeaways. Its formatting contributed to improved clarity and usability, making the resulting report easily accessible to end users. Despite being based on only three agents, the report demonstrated meaningful analytical value and communicative effectiveness.

As shown in Table 2, each agent in this multi-layered system has a clearly defined and focused role. The Market Scanner provides a numerical overview of key market changes (e.g., Bitcoin dropping by 2.72%, Cardano surging by 27.45%) and successfully highlights the most relevant signals without overwhelming the reader with data. The News Collector adds context by analyzing current events that explain market fluctuations, such as new SEC regulations or Ethereum’s network upgrades—enabling a more meaningful interpretation of the data.

Table 2. Selected examples from agent outputs in the analyzed report

Agent	Example
<i>Market Scanner</i>	“Cardano has experienced a remarkable price surge, likely driven by positive news or community developments...” “Bitcoin has experienced a moderate sell-off, likely influenced by broader market corrections...”
<i>Pattern Analyzer</i>	“BTC shows a bearish head and shoulders formation with support at \$29,000 and resistance at \$33,000, with RSI indicating oversold conditions.”
<i>News Collector</i>	“Bitcoin experienced a 2.72% drop over the past 24 hours, influenced by ongoing regulatory discussions...” “SEC Introduces New Guidelines for Crypto Exchanges...”
<i>Correlation Analyzer</i>	“BTC and Gold: Fluctuating correlation implies that BTC is not consistently serving as a safe-haven asset, unlike traditional safe-haven assets like Gold.”
<i>Conclusions Generator</i>	“The technical pattern combined with regulatory uncertainty suggests potential further downward pressure on Bitcoin.” “The decreasing correlation... suggests maturation and independence.”
<i>Final Report Creator</i>	“Bitcoin’s bearish pattern combined with regulatory scrutiny suggests potential further downward pressure...” “Cardano’s surge driven by positive developments indicates strong positive sentiment...”

The Pattern Analyzer applies technical indicators to identify potential price behavior patterns (e.g., BTC’s head and shoulders formation), while the Correlation Analyzer uncovers deeper market relationships—such as the weakening link between cryptocurrencies and traditional indices (e.g., BTC and the S&P 500), suggesting increased market independence.

The Conclusions Generator integrates all prior inputs into coherent insights using analytical reasoning (e.g., “regulatory uncertainty + bearish pattern → further decline in BTC”), while the Final Report Creator presents everything to the end user in a structured format, clearly divided into sections for readability and decision-making.

This approach enables a multi-dimensional analysis, where data is not only collected but also interpreted and contextualized through multiple independent and specialized layers. Thanks to this modular architecture, the system manages to preserve relevance, clarity, and depth—something that would not be achievable with a monolithic design. As a result, the user receives not just raw data but a clear, explained, and actionable report.

Overall, the system demonstrates the feasibility and added value of agent-based automation in cryptocurrency analysis, providing interpretable, actionable outputs across different levels of input complexity.

Despite the system’s demonstrated capability to automate cryptocurrency market analysis, several limitations were observed during implementation. One of the main challenges was the token limit of the LLaMA language model, which made it difficult to process longer or information-dense inputs. This occasionally required segmenting results or shortening summaries, leading to some loss of contextual coherence. The News Aggregator agent, which uses Exa AI, frequently reached its predefined execution time and iteration limits, reducing the volume of processed information and occasionally missing timely updates. These challenges highlight the need for more robust pre-processing, optimized querying strategies, and more flexible resource allocation in future versions of the system.

Although the proposed system shows potential for automated market analysis, several important limitations remain. First, reliance on external textual sources—particularly in the News Aggregator agent—introduces the risk of misinformation and low-quality content. The system currently lacks mechanisms for fact-checking or assessing source credibility.

Second, data bias may affect both the textual input and historical price patterns, potentially impacting the accuracy of generated interpretations.

Third, the system operates in periodic update cycles and is not fully responsive to rapidly changing market conditions. In highly volatile environments, this may reduce the timeliness of insights. Future improvements could include real-time data processing and enhanced handling of uncertainty.

5 Conclusion and Future Work

This study confirms that multi-agent systems can effectively automate the monitoring and interpretation of cryptocurrency market trends. By distributing specialized tasks across coordinated agents, the system significantly accelerates data processing while maintaining analytical depth. The layered approach—moving from real-time data collection to synthesized insight—enables users to obtain structured, actionable information with minimal manual effort. Moreover, the consistency of generated outputs with those produced by traditional analytical methods supports the system’s reliability and practical applicability in financial decision-making contexts.

Future development should focus on expanding model capabilities through the integration of alternative Large Language Models (LLMs), as well as exploring the benefits of fine-tuning and domain adaptation. The creation and augmentation of task-specific datasets could further improve accuracy and robustness, while systematic benchmarking against existing tools would enable more precise evaluation of performance and limitations.

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